BRIEFER ARTICLES

ROOT DEVELOPMENT OF WHEAT SEEDLINGS

(WITH ONE FIGURE)

In a study of the salt requirements of wheat in water cultures, certain conditions under which wheat seedlings developed relatively large root systems were noted. Wheat seedlings with shoots 8–10 cm. high and roots 10–12 cm. long were set out according to the usual method employed for solution culture experiments, in two quart Mason jars filled with tap water from the laboratory. The cultures were allowed to grow for six weeks at a temperature range of 22–32° C. and without renewal of the tap water. At the end of this period the tops of the cultures had grown about 12–16 cm. high (having gained from 2 to 4 cm.) and the root mass measured 70–80 cm. in length. In some cultures, however, single roots had attained a length of over 100 cm. So far as the total dry weight of these cultures was concerned, it may be stated that about one-half was contained in the roots.

It was at first thought that the relatively low total salt concentration of the tap water was responsible for the results. The tap water of the laboratory contained a total salt concentration whose osmotic value was calculated to be approximately equal to 0.1 atmosphere pressure. To test this supposition as being the cause for the extraordinary long root growth of the wheat seedlings, several different kinds of complete nutrient solutions were prepared, each having a total salt concentration giving an osmotic value equal to about 0.1 atmosphere pressure, and these were used as the culture media for wheat. These dilute solutions, which contained all of the chemical constituents essential for plant growth, proved to be relatively poor media for the root development of wheat seedlings. Another set of tests, however, with solutions of the same salts and salt proportions as those of these dilute solutions but of greater total concentration (0.5 atmosphere), proved to be very good media for the root development of wheat seedlings. These results suggested that it might be the absence or the deficiency of an element in the tap water that was responsible for the results. Tests were then made using nutrient solutions of a total salt concentration equal to give about 0.5 atmosphere osmotic pressure, but modified so as to omit one

of the elements considered essential for normal plant growth. Wheat seedlings with shoots 8–10 cm. high and roots 10–12 cm. long were placed in these different nutrient solutions. After the cultures had grown five weeks it was found that the set grown in solutions that lacked nitrogen had developed a root system similar and equal in length to those obtained from cultures grown in tap water. The tops of the plants grown in the relatively nitrogen-free solutions gained only a few centimeters in shoot length, but the root mass had attained a length of 60–70 cm. for the different cultures of the set. From these results it was concluded that stimulation of long root development of wheat seedlings grown in tap water was related to the deficiency of nitrogen in that growth medium.

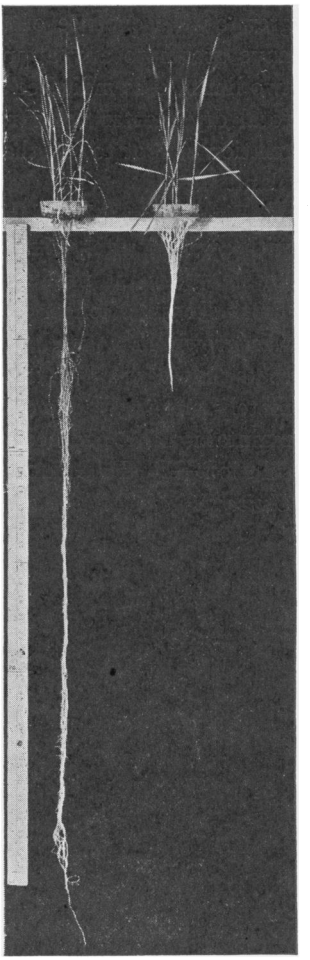

FIG. 1.—Culture to left grown in tap water for six weeks; culture to right grown in good nutrient solution for two weeks.

Two questions might be asked in reference to the results obtained: (1) Can plant roots grow without nitrogen? (2) What constitutes the best root development of a wheat plant for its normal growth? As to the first question, the tests did not prove that the large root development obtained from wheat seedlings grown in tap water or in the prepared nitrogen-free solutions was due to the total absence of nitrogen, or that it would have been obtained in the total absence of nitrogen. Obviously some nitrogen was contained in the seedlings when they were set in these media. Presumably less and less became available to the growing roots as the plants grew older, however, as the small supply originally in the seed had to suffice for more and more tissue (chiefly roots) as the seedlings enlarged. Whether the supply was ever exhausted in the growing region of the roots is not known.

An answer to the second question must also be given as a hypothesis. The large root development of the wheat seedlings placed in tap water did not result in the production of large wheat plants. The roots grew at the expense of the tops. Obviously wheat shoots could not have grown to any appreciable extent without roots, so between the two limits thus indicated (no roots on the one hand, and one-half of the total dry matter being roots on the other hand) must be found that relation of root to top that will bring about the best growth of the wheat plant.

Fig. 1 shows the relative root development of two different cultures, with approximately similar top growth. One was grown in tap water for six weeks and produced roots over 100 cm. long, the root mass being about six times longer than the length of the tops. The other culture was grown in a good nutrient solution for two weeks and produced roots that were only a trifle longer than the length of the tops. Approximately this same ratio of length of root to that of top would have been maintained if it had been grown six weeks or longer in this good nutrient solution.—W. F. GERICKE, *Division of Soil Chemistry and Bacteriology, University of California.*